Tunable and rapid self-assembly of block copolymers using mixed solvent vapors

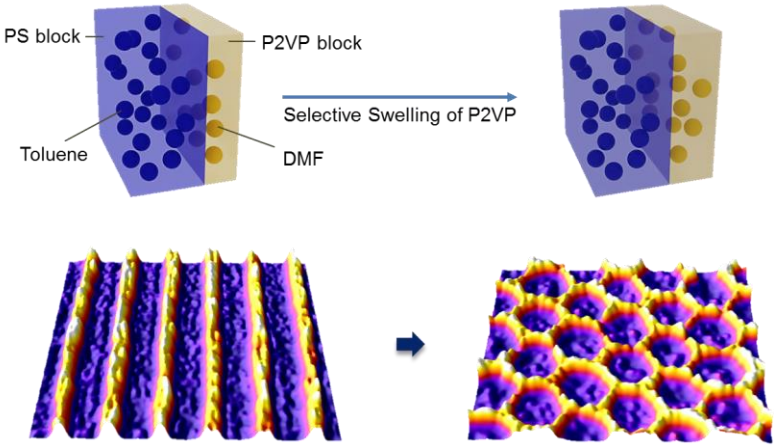

Figure 1. Schematic of the self-assembled cylinder-forming PS-*b*-P2VP BCP using mixed solvents of DMF and toluene. (Upper) Effective volume fraction (f_{P2VP}^{eff}) increases in proportion to the volume fraction of DMF to toluene. (Lower) Morphological change from line to honeycomb patterns by tuning f_{P2VP}.

W. I. Park, S. Tong, Y. Liu, I. W. Jung, A. Roelofs, & S. Hong *Nanoscale* **6**, 15216–15221 (2014)

The work was supported by the U.S. Department of Energy, Office of Science, Materials Sciences and Engineering Division. Use of the Center for Nanoscale Materials for SEM and RIE experiments was supported by the U. S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357.

Scientific Achievement

We developed a tunable and rapid self-assembly process of block copolymers with high Flory-Huggins interaction parameter (χ).

Significance and Impact

Our research provided a solution toward bottom-up approach of tunable nano-lithography with high speed and a platform for mesoscale functional honeycomb structures, e.g. resistive switching oxide networks.

Research Details

- Various nanostructures such as line, honeycomb, hole, and lamellar patterns were obtained by precise control of the DMF:toluene volume ratio.
- We are the first to report a unique morphology of a honeycomb with hexagonal holes at the nanoscale.
- Pattern formation of 12-nm-width lines was effectively achieved within one minute *via* a mixed solvent treatment due to the drastic reduction in activation energy for chain diffusion.